THE SKOMER VOLE (CLETHRIONOMYS GLAREOLUS SKOMERENSIS) AND LONG-TAILED FIELD MOUSE (APODEMUS SYLVATICUS) ON SKOMER ISLAND, PEMBROKESHIRE IN 1960

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ABSTRACT

The method used to estimate the total population of the Skomer vole (Clethrionomys glareolus skomerensis) on Skomer Island in September 1960 is described. The technique involved both line and grid trapping and the deductions to be made from these methods are discussed. In addition to the vole large numbers of the field mouse (Apodemus sylvaticus) were trapped and information was gathered on the ecological relation between the two species. The vole was most numerous in dry, deep bracken but also occurred in smaller numbers in the areas having scattered bracken with grass undercover. Field mice were trapped in greatest numbers in the more exposed areas, especially on cliff slopes and on bare rock outcrops. The distribution on Skomer Island of these two species is discussed. Figures for the population sizes of both voles and field mice on two areas are given. Half the voles and field mice captured were young animals. Breeding was still in progress. Data are presented for body weights, in relation to sex and age, for both species.

INTRODUCTION

This survey of the distribution and population of the Skomer vole (Clethrionomys glareolus skomerensis) on Skomer Island, Pembrokeshire, was carried out during the late summer of 1960. Its immediate aim was to gain information about the abundance of this vole before taking specimens for a study of the histophysiology of its reproductive cycle similar to that made by Brambell & Rowlands (1936) and Rowlands (1936) on the mainland species Clethrionomys glareolus britannicus (Miller). The survey also offered the opportunity to experiment in methods that might be used to determine the total number of small mammals on an island.

The taxonomic position of the Skomer vole has been much discussed. It is now believed to be a recently evolved island form of C. glareolus and does not justify the specific rank of C. skomerensis given to it by Barrett Hamilton (1903). Steven (1953) regards it as a well-differentiated subspecies and an appropriate nomenclature is that adopted by Ellerman & Morrison Scott (1951) and used by Matthews (1952). The Skomer vole and mainland bank vole will interbreed (Steven, 1955; Godfrey, 1958) giving fertile hybrids and Godfrey (1958) has investigated experimentally the mating behaviour of the voles and the viability of the hybrids. Corbet (1961) in his reassessment of some of the insular races of British mammals upholds the view that the Skomer vole is an accidental post-glacial introduction by man.

There are four species of small mammals on Skomer including the vole, the others are the Common shrew (Sorex araneus), the Pygmy shrew (Sorex minutus) and the Long-tailed field mouse (Apodemus sylvaticus). The only recent information available about these animals on Skomer is a brief account by Phillips (1950) and certain data on body measurement of the vole and field mouse by Phillips & Worden (1950); Matthews (1952) has recorded some field notes in his general account of the biology of the bank vole.

The island carries a population of rabbits (Oryctolagus cuniculus) that exert in places a heavy grazing pressure. Their numbers fluctuate widely from year to year: they were heavily reduced in 1955 by myxomatosis and in 1959 by a severe drought, so that numbers appeared to be low in 1960. A small flock of Soay sheep graze the island, but only 14 were present during the time of our study.

METHODS

Intensive trapping using 214 small mammal traps was carried out between 28th August and 8th September1960. The first seven days were spent in line trapping along a number of transects across the island (see Fig. 5) followed by grid trapping in selected small areas between 3rd September and 8th September.

Traps. The trap used was the Longworth small mammal trap (Chitty & Kempson, 1949). The treadle mechanism operating the door was adjusted so that it could not be triggered off by a dead weight of less than 10 g. This was done to avoid the capture and possible killing of shrews and was moderately successful in so far as in a total of 2,363 settings only 20 shrews were caught. Traps were set ready-stocked with crushed oats as bait and a wisp of hay as nesting material; a prebaiting period was not allowed. Trapping positions were marked by 4-foot-long bamboo canes.

Examination of captured animals. A subdivision into broad age groups was made. The smallest animals with distinctive dark infant coat colour were classified as juveniles. Larger animals, having moulted from this pelage to the adult type were classified as immatures when it was clear from the external genitalia that they were not yet sexually mature. The remaining group was that of adults; adult males were distinguished by having scrotal testes; all females with a perforated vagina were considered adult, and also any pregnant or parous females in which the vagina may not have been in a perforate condition. Pregnancy (middle and late stages) was diagnosed by palpation; the parous condition by the development of the teats. The animals were weighed in a polythene bag on a spring balance (range 0 to 50 g). All animals were released after examination.

Line trapping. Seven separate lines were worked: lines I, IIa, IIb, III, IV, V and VI (see Fig. 5). Lines IIa and IIb were each laid out with half the available traps and were worked concurrently. Line VI was a short line laid at right angles to line IV to test how far the findings on line IV applied to the surrounding area. Each line was laid out with ranging rods and a prismatic compass along a predetermined compass bearing. The line positions could then be accurately plotted on a map (Ordnance Survey Pembrokeshire sheets XXXI, 6, 7, 10 and 11 at 25 in. to one mile). Traps were set in groups of four or more at points 35 yards apart along the length of the line (this interval is equivalent to i in. on the Ordnance sheets). The traps were put down within a radius of four feet of each point. When trapping had started it was frequently found that all four traps at a point were occupied. When this happens other voles or field mice in the region are excluded from entering the traps and the sample caught may be unrepresentative. For this reason the number of traps at a point was increased on some lines to six or eight; details are presented under Results. Traps were laid out and set between 11.00 and 12.30 G.M.T. and examined between 18.30 and 19.30 G.M.T. Animals captured at this time had their fur clipped to identify them in case they were caught again. The traps were reset in the same positions and were examined and lifted the following morning between 08.30 and 11.00 G.M.T. This system

gave an average of 72 hours between midday and late evening for the day catch and 14t hours for the overnight catch.

Grid trapping. In order to estimate the total number of animals in a given area the traps were set out on a grid pattern, and a procedure for calculation adopted as in the recapture method described by Hayne (1949). The use of this method is discussed by Brown (1954), and Zippin (1958) has stated that the recapture method is more reliable than the removal method. Two grids, A and (D, were employed, laid out in areas of medium and high vole density respectively. Each grid was pegged out as a large square orientated so that the sides ran N-S and E-W and subdivided into small squares with ten yard sides. Grid A contained 36 small squares (3600 sq. yds.) and grid C 25 small squares (2500 sq. yds.). Trapping was carried out for five days on grid A, with two traps set in each small square; on grid C trapping was for four days with three traps in each square. The traps were placed in a group near one corner of a square and were moved clockwise on each succeeding day to a position near the next corner. Each animal was aged, sexed and weighed and in addition was individually marked with a numbered monel-metal ring, on the hind leg. The grid traps were set for 24 hours and were examined and moved every morning (08.30 to 11.00 G.M.T.).

The grid trapping and line trapping results, together with information about the distribution of habitat types, were applied to a calculation of the total number of voles on the island.

POSITION, CLIMATE, TOPOGRAPHY AND VEGETATION OF SKOMER

Skomer is an island of 720 acres lying at the tip of the southern peninsula of St Brides Bay, West Wales. Between it and the mainland lies Middleholm of 21 acres. Skomer is composed mainly of igneous rocks almost wholly of volcanic origin (Jones, 1950) and has a main plateau height of 200 feet above sea level that is common to this part of Pembrokeshire. Skomer, although subject to strong winds and storms, has an extremely mild climate with little frost and long periods of clear weather. A general account of the island is given by Buxton & Lockley (1950).

Topographical and vegetational features of Skomer have in general a west to east orientation (see Fig. 6) so that a transect of the island from north to south (e.g. line I, Fig. 5) crosses a sample of most types of habitat.

The central plateau was farmed up to 1890 and was occasionally cultivated until 1948. (:lose to its highest point stand derelict farm buildings surrounded by numerous walled fields. Amongst these fields, particularly along the cliff area, there remain parts of an ancient system that dates from prehistoric times; a description, map and photographs are given by Grimes (1950).

Bracken (Pteridium aquilinum) has come to occupy large areas of the island, but many of the fields enclosed by the dry-stone earth-filled walls were clear of bracken, and in them there was a well-grazed turf. The perimeter of the island and other exposed areas not covered by a bracken community were dominated by rank-grown grasses, while parts of the western side of the island and the Wick were dominated by thrift (Armeria maritima). There are several areas of heathland, mainly along the northern ridge. (A detailed description, and list of the flora, are given by Sadd, 1950, and Sladen, 1950.)

To the north and south of the central plateau are North Stream valley and South Stream valley respectively, each being a rather marshy area and each drained by a stream running eastwards to the sea; north and south again of these valleys are ridges of high ground from which the land slopes to the cliffs.

A large number of bare rock outcrops, used by gulls as breeding and feeding sites, are an important feature of the island. Large numbers of other sea birds, both those that nest in the open and in burrows, use the island as a breeding ground, and create a variety of special local habitats.

DISCUSSION

The two small mammal species C. glareolus and A. sylvaticus are frequently found inhabiting the same areas, and the ecology of this relationship has attracted much study. A habitat distinction can be fairly readily shown in which the bank vole favours areas with some scrub cover, whereas the field mouse will range over more open country. On the other hand, in the mixed habitats of English and Scottish woodland there may not be a discernible difference in the distribution of the two animals (Evans, 1942; Delany, 1957).

The findings on Skomer show in a striking manner that a single species may be dominant in a particular habitat, but it is a situation where, at the extremes of dense bracken and bare rock, the habitats are in sharp contrast. In woodland with varied ground cover, Evans (1942) did notice a general, but not always consistent association between bank voles and bracken. On Skomer the association was very close except where a low ground cover of wet grass deterred the voles. The areas of high vole density were shunned by the field mice and it appears likely that the abundant voles were excluding the mouse. Brown (1954) found that high Microtus agrestis numbers will similarly restrict the range of A. sylvaticus. An opposite effect cannot be suggested for those areas (as on the Neck, line V) where the field mouse abounded, because these were areas of open or sparse vegetation that in any case would not harbour many voles. The nocturnal mouse, however, is able to exploit these areas and is, moreover, attracted to them by food debris scattered by gulls that use rock outcrops as feeding stations.

When the two species (C. g.. britannicus and A. sylvatica share the same habitat there is a well-marked alternation of activity, one animal being diurnal and the other nocturnal (Miller, 1955; Brown, 1956). We found this to be true on Skomer (see also Saunders, 1961) where a great many voles but no field mice were caught in the daytime trapping periods. All the field mice were caught in the overnight trapping periods. The majority of vole captures were also made in these overnight periods, which, it will be recalled, included the hour of dusk and several hours of early morning light. If a high proportion of these voles had occupied the traps in a dusk period of activity then, in many places, few traps would have been left available for the nocturnal field mouse. The outcome would have been a seriously biased sample, but there is evidence to indicate that the general picture of the relative numbers and distribution of the two species is reliable.

Firstly in each of points 15 to 19 on line I, all four traps were occupied overnight by voles, and field mice were apparently absent. That this was so, and that mice were not simply being excluded by voles was shown when subsequently grid C was set up here with 75 traps and in four days of trapping 75 voles were caught but only four field mice.

Secondly, in a similar way on line III, confirmation of the line trapping results was given by grid trapping results. Between points 32 and 35 on the line equal numbers of voles and mice had been caught; grid A showed that the two species were indeed present in equal numbers in the area and,

moreover, as indicated by the line trapping, the local population was less dense than in the grid area.

Finally, on line IV steps had been taken to increase the numbers of traps at a point from 4 to 6, and between points 4 and 9 inclusive a heavy vole catch was obtained in the 36 traps available. Examination of the field data, however, shows that during the overnight period 15 of these traps were not occupied by voles and, presumably, were available for field mice. Of these only three were in fact occupied by field mice, the rest remaining empty. It is true, in considering :Fig. 5, that a greater contrast would have been demonstrated between areas of high and low density if more traps had been available at every point, and probably a relatively greater total of field mice would have been caught, but the general impression of the distribution of the two species remains valid.

The total population of voles calculated for the island is given in Table 4, and these figures supersede the preliminary calculation given by Fullagar, Jewell, Lockley &; Rowlands (1961). The many assumptions made in arriving at the figures will be apparent from the procedure described and they must be regarded as speculative. Figures for the numbers of field mice per acre were obtained only for regions where mice were very scarce (grid C) or at medium density (grid A). In the absence of information on the density of mice in areas where they were abundant no useful figure for the total field mouse population can be given. A relevant fact, however, is that in the line trapping (I-V) which gave a fair coverage of the island, the total numbers of voles and mice caught were 230 and 220 respectively. This suggests that the numbers of the two species were of the same order of magnitude.

The data on body weights presented in Figs. 1 to 4 can be used to determine the structure of the populations at the time of the survey. Nearly half of the individuals captured were young animals; 172 of the 341 voles and 96 of the 225 field mice were recorded as either juvenile or immature. Probably greater numbers of juvenile animals would have been captured if the traps had not been adjusted to prevent the capture of very light animals (see Methods). In spite of this a high proportion of young animals was caught showing that the populations were still gaining recruits. The large number of young adult males and of young pregnant females implies a considerable potential for further expansion.

The category of " adult animal " has been taken to include all those that were sexually mature (see Methods). In both species there is a weight range that includes both immature and adult animals (Figs. 1 to 4). In the lower weight classes of this range the majority of the animals are immature whereas in the upper ones they are adult. It would seem that the new animals recruited into the population reach a body weight of 20 to 22 g in the case of the vole and 19 to 20 g in the case of the field mouse, before becoming sexually mature.

The extension of the range of weights of mature animals into the lower weight categories in both species indicates that quite a large number of voles and field mice were breeding as young animals in their first year; these would be

animals born early in 1960 and rapidly maturing to become sexually adult before the end of the breeding season. Inspection of our field notes confirms this view as frequently the adult animals of the 20 to 30 g body weight groups in voles and 15 to 25 g groups in mice, were recorded as young adults, not being animals that had overwintered. It cannot be determined, from our data, how far the animals recorded as immature in early September might also mature and breed before the end of the 1960 breeding season. There is seen to be an accumulation of voles in the 20 to 22 g classes and mice in the 19 g class. It seems likely that these young animals remain at this weight over the winter and body growth is not resumed until sexual maturity is reached the following spring. This possible relation between body growth and sexual maturity requires further investigation.

Nothing is known, as yet, of how the numbers of voles on Skomer vary from year to year or fluctuate with the seasons. The September survey was made at a time when most small mammal populations are at or near their peak, but even so the bank vole on Skomer may well reach densities that are high for the species. (It may be noted that although the broken patch of grid C was not completely isolated it was bounded on the south side by an earth and stone wall, and on the north and west by a zone of damp ground and sparser bracken. Our maximal figure of 139 voles to the acre in deep bracken areas may thus be near a true estimate.)

An investigation of the factors that enable the voles to thrive under these conditions, and of their ecological relation to the field mice, will be a necessary accompaniment to the full study of their breeding biology.

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SUMMARY

1. Trapping was carried out on Skomer Island from 28th August to 8th September 1960. Two hundred and fourteen Longworth small mammal traps were used. A method of estimating the total island population of the Skomer vole (Clethrionomys glareolus skomerensis) in this time, involving both line and grid trapping, is described. Both small rodents on the island, the Skomer vole and the field mouse (Apodemus sylvaticus) were trapped, but the traps were adjusted to avoid the capture of common and pigmy shrews (Sorex araneus and Sorex minutus).

2. A total of 230 voles and 220 field mice were captured on five trap lines that ranged across all parts of the island. Voles favoured the drier more sheltered areas, especially deep bracken (Pteridium aquilinum). Smaller numbers of voles were captured in the areas with more scattered bracken and an undercover of grass; field mice were frequently as abundant as voles in such places. Field mice were most numerous in the more exposed sites, particularly the cliff slopes and rock outcrops, where there was often little ground cover.

3. A correlation was established between vole distribution density and the bracken habitats. These habitats were plotted from botanical survey data on a map as three categories—high, medium and low vole density areas.

4. By grid trapping in selected high and medium vole areas on the island, population figures were calculated using the method described by Hayne (1949). The interpretation of these data is discussed especially with regard to the " edge effect " in grid trapping. Average effective ranges of the voles in both situations were calculated from " range lengths " and these have been considered in the adjustment of the area being sampled in both cases by the addition of half this average to the borders of the two grids. In a high vole density habitat, that is deep dry bracken, the straight population on one grid was 139 voles per acre; corrected for " edge effect " this gave 85 voles per acre. In a medium density habitat, scattered bracken with grass undercover, the straight population was 23 voles per acre, or, when corrected, 12 voles per acre. No grid trapping was carried out in a low density vole area.

5. Using the data from the grid trapping combined with the map of the distribution of the vole population on Skomer, a figure between 17,000 and 27,000 was calculated as a speculative estimate of the total number of voles present in September 1960.

6. The range of weight for adult voles was from 23 to 44-5 g in 83 males and 20 to 45 g in 88 females. Similarly for adult field mice the range was from 17 to 34 g in 77 males and 14 to 40 g in 83 females. In 341 voles the sex ratio was male: female, 11: 1 and in 225 field since, 2-17: 1.

7. Nearly half of all animals captured were young and sexually immature. Many females of both voles and field mice were found to be pregnant and breeding was still in progress.